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Bacterial Adhesion On Implant Surfaces Subjected To Different Treatments: In Vitro Study

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ABSTRACT

Introduction: The surface treatment can be listed among the multiple risk factors for peri-implantitis. The treatment can affect the micro- and nano-morphology of the surface but also the physical structure. TiO2 exists naturally in amorphous or crystalline form such as anatase or brookite. The aim of this study was to evaluate the antibacterial features of grade IV and grade V titanium implants subjected to four different surface treatments.

Methods: Grade IV and V titanium disks were subjected to the following surface treatments: machining (G1), machining and anodization (G2), sandblasting and etching (G3) and sandblasting, etching and anodization (G4). MicroRaman spectroscopy was used to evaluate the physical structure of the surface. A reference strain of S. aureus (ATCC BAA-1717) was used for the in vitro bacterial adherence test. The results were expressed as Colony Forming Units (CFU).

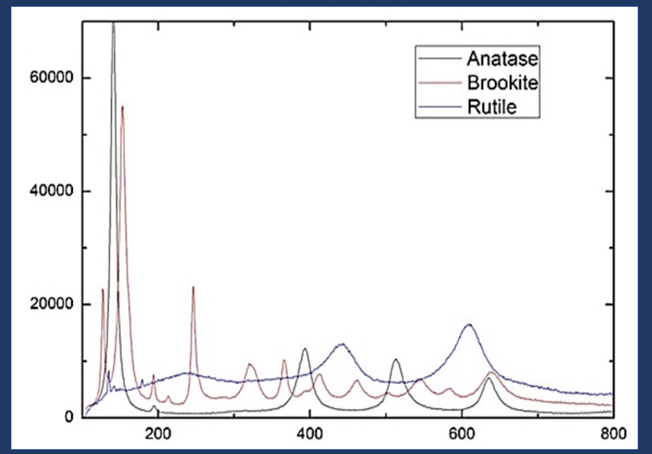
Results: Grade V titanium samples did not show crystalline structural organization regardless of surface treatment. Of the grade IV samples, only the G4 group showed a Raman signal unequivocally attributable to the presence of anatase. In grade V samples, anodizing increased the antibacterial activity only on the micro-rough surfaces. In grade IV samples, the anodization treatment reduced bacterial adhesion on both the machined and micro-rough surfaces. The anodizing treatment allowed to reduce bacterial adhesion.

Conclusions: Bacterial adhesion is influenced by the surface treatment and the bulk material. Surfaces that reduce bacterial adhesion could reduce the onset of peri-implant pathologies.

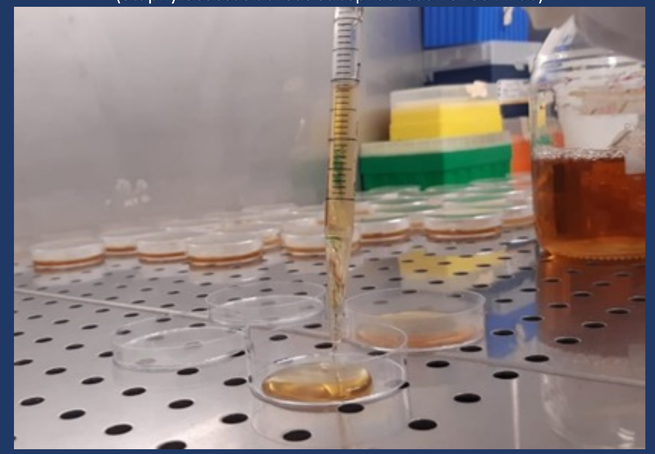
METHODS

Group name	Bulk material	Surface treatment	Anodization
G1	Grade V	Machined	No
G2	Grade V	Machined	Yes
G3	Grade V	Sandblasted and double etched	No
G4	Grade V	Sandblasted and double etched	Yes
G1CP	Grade IV	Machined	No
G2CP	Grade IV	Machined	Yes
G3CP	Grade IV	Sandblasted and double etched	No
G4CP	Grade IV	Sandblasted and double etched	Yes

RAMAN SPECTROSCOPY



BACTERIAL ADHESION ANALYSIS
(Staphylococcus aureus subsp. aureus 23235 ATCC)



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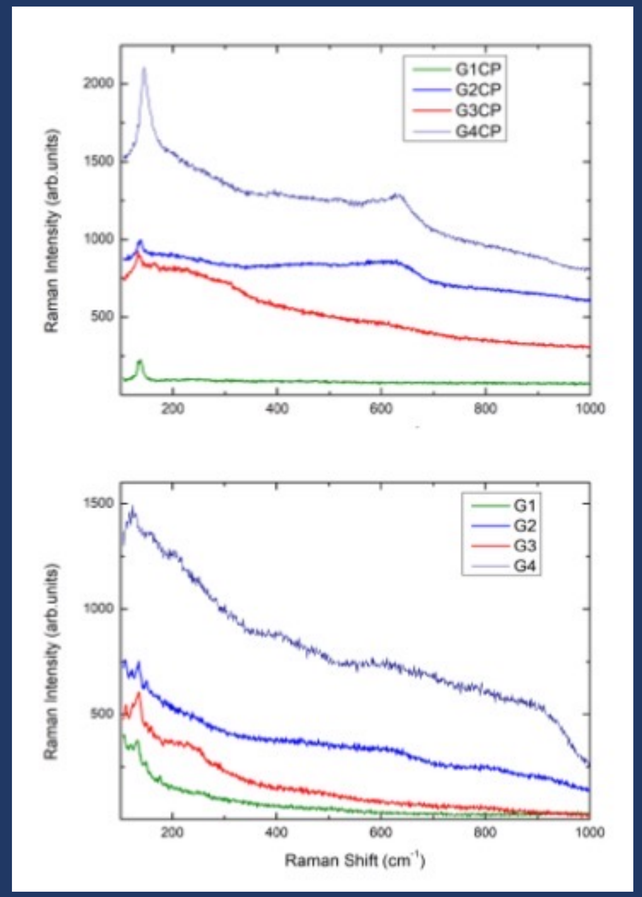
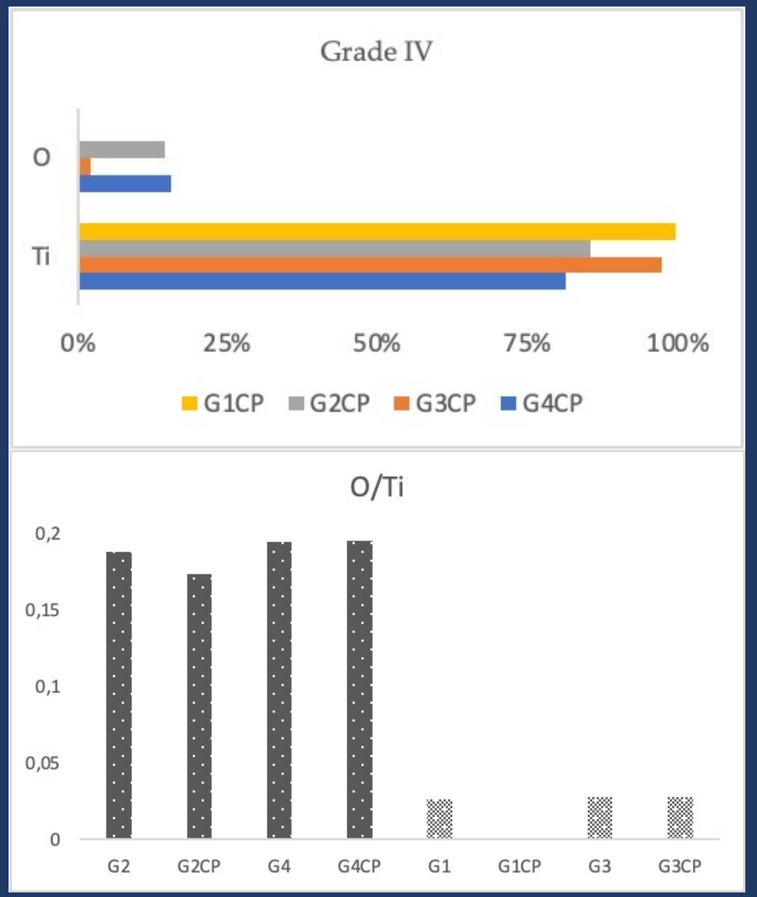
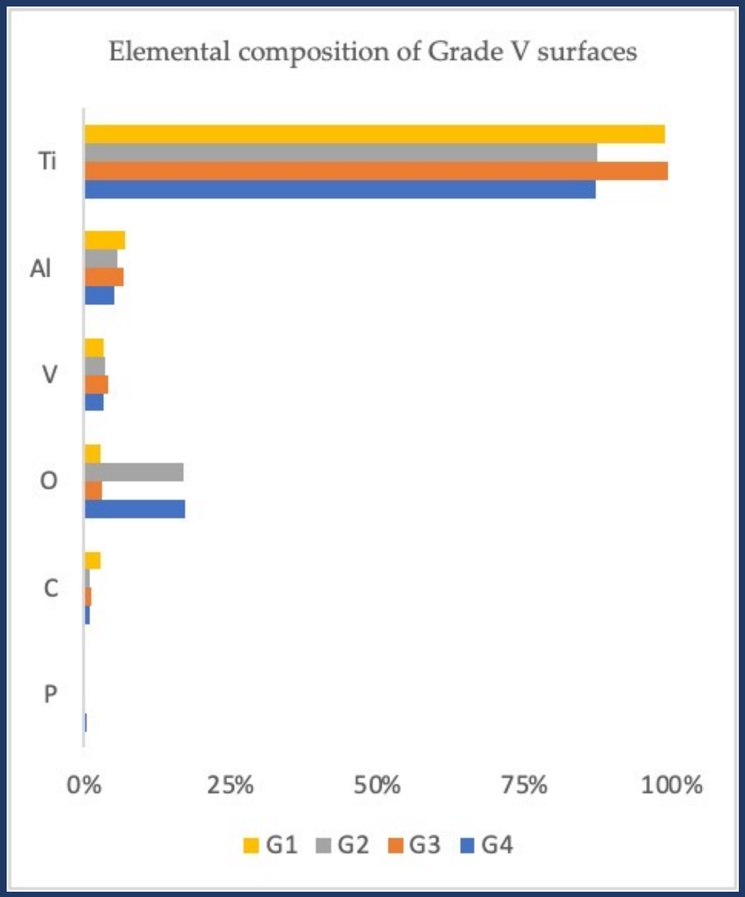
RESULTS







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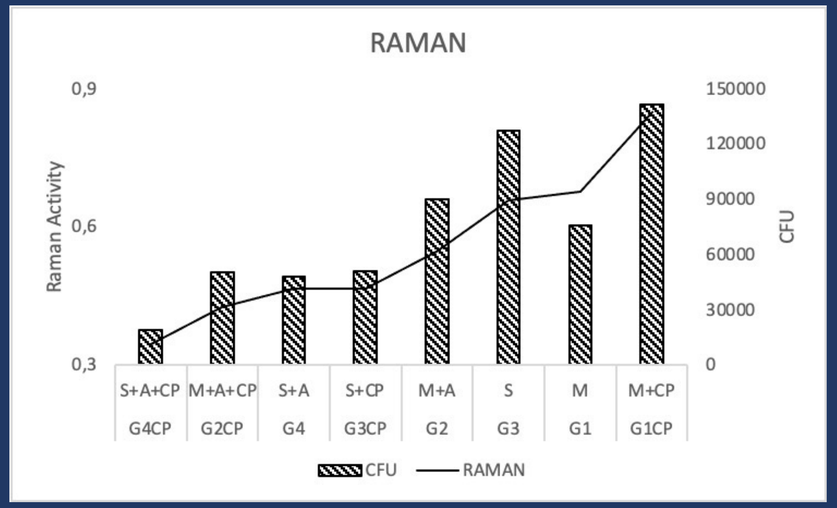

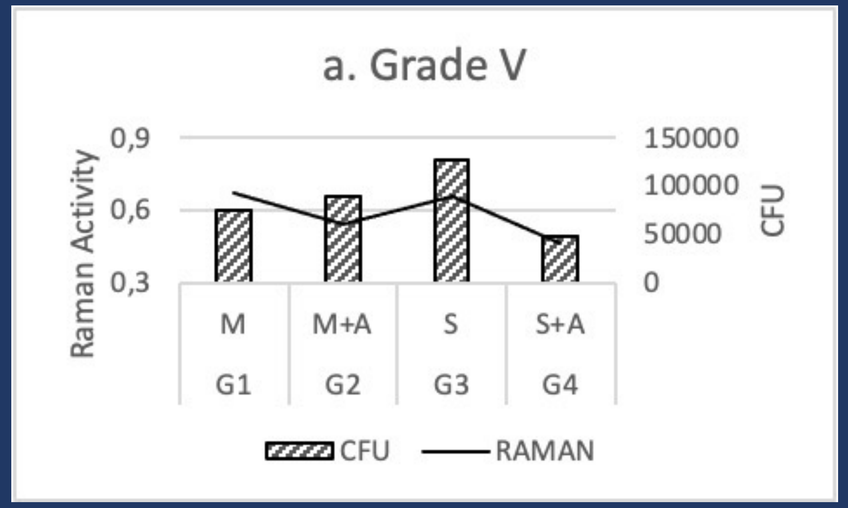

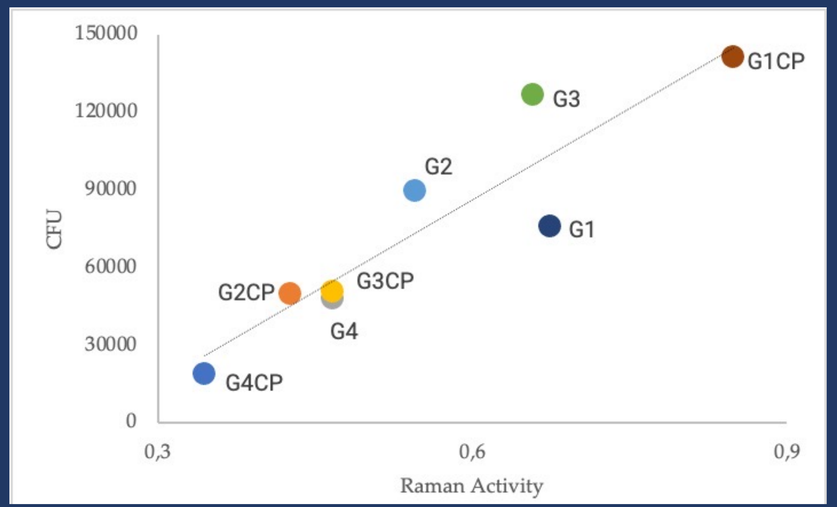

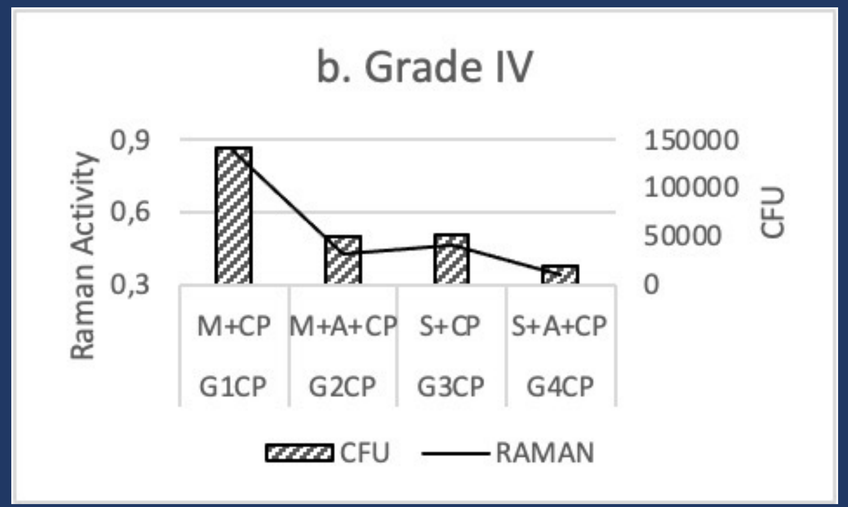

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CONCLUSIONS

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- The ideal surface that combines osteogenic and antimicrobial characteristics has not yet been identified
- Surfaces free from contamination
- Physical and chemical characteristics influenced not only by the treatment itself, but also by the bulk material
- The amount of the oxide layer on the surfaces correlates very well with the observed CFU
- The amount of the oxide layer on the surfaces can be a useful parameter for further studies of bacterial growth on implant surfaces
- With the same bulk material and surface treatment, anodizing has increased antibacterial capabilities

LIMITS

- This study is an in vitro study
- Only a bacterial strain of Staphylococcus Aureus was used.
- The antimicrobial characteristics alone are not enough to define the usability of a given implant surface: in fact, other characteristics, such as the affinity for osteoblastic growth and biocompatibility, must be considered

Thanks for attention